



**OPA244**  
**OPA2244**  
**OPA4244**

## MicroPower, Single-Supply OPERATIONAL AMPLIFIERS

### MicroAmplifier™ Series

## FEATURES

- **MicroSIZE PACKAGES**  
 OPA244 (Single): SOT-23-5  
 OPA2244 (Dual): MSOP-8  
 OPA4244 (Quad): TSSOP-14
- **MicroPOWER:**  $I_Q = 50\mu\text{A}/\text{channel}$
- **SINGLE SUPPLY OPERATION**
- **WIDE BANDWIDTH:** 430kHz
- **WIDE SUPPLY RANGE:**  
 Single Supply: 2.2V to 36V  
 Dual Supply:  $\pm 1.1\text{V}$  to  $\pm 18\text{V}$

## APPLICATIONS

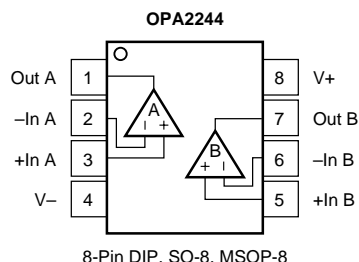
- **BATTERY POWERED SYSTEMS**
- **PORTABLE EQUIPMENT**
- **PCMCIA CARDS**
- **BATTERY PACKS AND POWER SUPPLIES**
- **CONSUMER PRODUCTS**

## DESCRIPTION

The OPA244 (single), OPA2244 (dual), and OPA4244 (quad) op amps are designed for very low quiescent current ( $50\mu\text{A}/\text{channel}$ ), yet achieve excellent bandwidth. Ideal for battery powered and portable instrumentation, all versions are offered in micro packages for space-limited applications. The dual and quad versions feature completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

The OPA244 series is easy to use and free from phase inversion and overload problems found in some other op amps. These amplifiers are stable in unity gain and excellent performance is maintained as they swing to their specified limits. They can be operated from single (+2.2V to +36V) or dual supplies ( $\pm 1.1\text{V}$  to  $\pm 18\text{V}$ ). The input common-mode voltage range includes ground—ideal for many single supply applications. All versions have similar performance. However, there are some differences, such as common-mode rejection. All versions are interchangeable in most applications.

All versions are offered in miniature, surface-mount packages. OPA244 (single version) comes in the tiny 5-lead SOT-23-5 surface mount, SO-8 surface mount, and 8-pin DIP. OPA2244 (dual version) is available in the MSOP-8 surface mount, SO-8 surface-mount, and 8-pin DIP. The OPA4244 (quad) comes in the TSSOP-14 surface mount. They are fully specified from  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  and operate from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . A SPICE Macromodel is available for design analysis.



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 Twx: 910-952-1111 • Internet: <http://www.burr-brown.com/> • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$

At  $T_A = +25^{\circ}C$ ,  $R_L = 20k\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA244NA, PA, UA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^{\circ}C$ to $85^{\circ}C$ vs Temperature vs Power Supply $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu V/^{\circ}C$ $\mu V/V$ $\mu V/V$
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1kHz$ to $10kHz$ Input Voltage Noise Density, $f = 1kHz$ Current Noise Density, $f = 1kHz$	$e_n$ $i_n$		0.4 22 40		$\mu Vp-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 84 <b>84</b>	98	$(V+) - 0.9$	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^{\circ}C$ to $85^{\circ}C$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR $G = 1$ 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 -0.1/+0.16 150 8		kHz V/ $\mu s$ $\mu s$ $\mu s$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Short-Circuit Current Capacitive Load Drive	$V_O$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $I_{SC}$ $C_{LOAD}$	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> 0.1 <b>0.1</b> -25/+12	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b> -25/+12		V V V V V V V V mA
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_S$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $I_Q$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 50	<b>+36</b> 60 <b>70</b>	V V $\mu A$ $\mu A$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance SOT-23-5 Surface-Mount SO-8 Surface-Mount 8-Pin DIP	$\theta_{JA}$	-40 -55 -65		85 125 150	$^{\circ}C$ $^{\circ}C$ $^{\circ}C$ $^{\circ}C/W$ $^{\circ}C/W$ $^{\circ}C/W$

NOTE: (1)  $V_S = +15V$ .

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# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

At  $T_A = +25^\circ\text{C}$ ,  $R_L = 20\text{k}\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA2244EA, PA, UA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ vs Temperature vs Power Supply $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Channel Separation	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5 140	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu\text{V}/^\circ\text{C}$ $\mu\text{V}/V$ $\mu\text{V}/V$ dB
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1\text{kHz}$ to $10\text{kHz}$ Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$	$e_n$ $i_n$		0.4 22 40		$\mu\text{Vp-p}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{fA}/\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 72 <b>72</b>	98	$(V+) - 0.9$	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel \text{pF}$ $\Omega \parallel \text{pF}$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR G = 1 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 $-0.1/+0.16$ 150 8		kHz V/ $\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Short-Circuit Current Capacitive Load Drive	$V_O$ $I_{SC}$ $C_{LOAD}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground See Typical Curve	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> $(V+) - 0.75$ $(V+) - 0.75$ $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b> $-25/+12$	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b>		V V V V V V V V mA
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current (per amplifier) $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_S$ $I_Q$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 40	<b>+36</b> 50 <b>63</b>	V V $\mu\text{A}$ $\mu\text{A}$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance MSOP-8 Surface-Mount SO-8 Surface-Mount 8-Pin DIP	$\theta_{JA}$	-40 -55 -65		85 125 150	$^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$

NOTE: (1)  $V_S = +15V$ .

# SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

**Boldface** limits apply over the specified temperature range,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

At  $T_A = +25^\circ\text{C}$ ,  $R_L = 20\text{k}\Omega$  connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA4244EA			UNITS
		MIN	TYP <sup>(1)</sup>	MAX	
<b>OFFSET VOLTAGE</b> Input Offset Voltage $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ vs Temperature vs Power Supply $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Channel Separation	$V_{OS}$ $V_S = \pm 7.5V, V_{CM} = 0$ $dV_{OS}/dT$ $PSRR$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		$\pm 0.7$ $\pm 4$ 5 140	$\pm 1.5$ $\pm 2$ 50 <b>50</b>	mV mV $\mu\text{V}/^\circ\text{C}$ $\mu\text{V}/V$ $\mu\text{V}/V$ dB
<b>INPUT BIAS CURRENT</b> Input Bias Current Input Offset Current	$I_B$ $I_{OS}$ $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 $\pm 1$	-25 $\pm 10$	nA nA
<b>NOISE</b> Input Voltage Noise, $f = 0.1\text{kHz}$ to $10\text{kHz}$ Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$	$e_n$ $i_n$		0.4 22 40		$\mu\text{Vp-p}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{fA}/\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE RANGE</b> Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_{CM}$ CMRR $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	0 82 <b>82</b>		$(V+) - 0.9$ 104	V dB dB
<b>INPUT IMPEDANCE</b> Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel \text{pF}$ $\Omega \parallel \text{pF}$
<b>OPEN-LOOP GAIN</b> Open-Loop Voltage Gain $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$A_{OL}$ $V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 <b>86</b>	106		dB dB
<b>FREQUENCY RESPONSE</b> Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR $G = 1$ 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 $-0.1/+0.16$ 150 8		kHz $\text{V}/\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
<b>OUTPUT</b> Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Positive $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Voltage Output, Negative $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ Short-Circuit Current Capacitive Load Drive	$V_O$ $I_{SC}$ $C_{LOAD}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to $V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega$ to Ground See Typical Curve	$(V+) - 0.9$ <b><math>(V+) - 0.9</math></b> 0.5 <b>0.5</b> 0.1 <b>0.1</b> $-25/+12$	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 <b>0.2</b> $(V+) - 0.75$ $(V+) - 0.75$ 0.1 <b>0.1</b>		V V V V V V V V mA
<b>POWER SUPPLY</b> Specified Voltage Range Minimum Operating Voltage Quiescent Current (per amplifier) $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$V_S$ $I_Q$ $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ $I_O = 0$ $I_O = 0$	<b>+2.6</b>	+2.2 40	<b>+36</b> 60 <b>70</b>	V V $\mu\text{A}$ $\mu\text{A}$
<b>TEMPERATURE RANGE</b> Specified Range Operating Range Storage Range Thermal Resistance TSSOP-14 Surface Mount	$\theta_{JA}$	-40 -55 -65		85 125 150	$^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}$ $^\circ\text{C}/W$

NOTE: (1)  $V_S = +15V$ .

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Supply Voltage, V+ to V- .....	36V
Input Voltage Range <sup>(2)</sup> .....	(V-) – 0.3V to (V+) + 0.3V
Input Current <sup>(2)</sup> .....	10mA
Output Short-Circuit <sup>(3)</sup> .....	Continuous
Operating Temperature .....	–55°C to +125°C
Storage Temperature .....	–65°C to +150°C
Junction Temperature .....	150°C
Lead Temperature (soldering, 10s) .....	300°C
ESD Capability .....	2000V

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Inputs are diode-clamped to the supply rails and should be current-limited to 10mA or less if input voltages can exceed rails by more than 0.3V. (3) Short-circuit to ground, one amplifier per package.



## ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

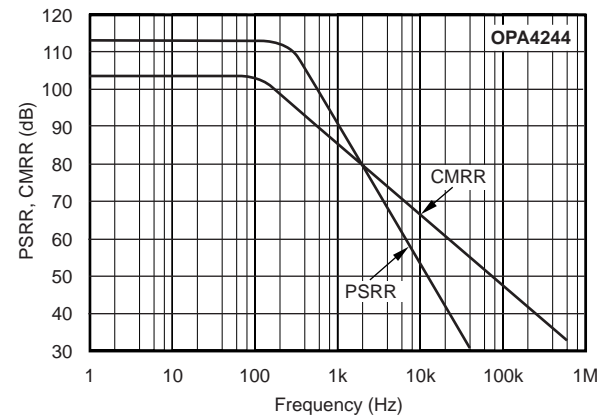
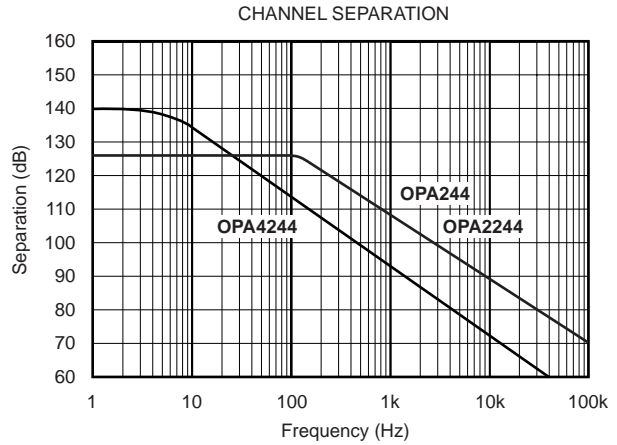
## PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER <sup>(1)</sup>	TRANSPORT MEDIA
<b>Single</b>						
OPA244NA "	SOT-23-5 Surface-Mount "	331 "	–40°C to +85°C "	A44 "	OPA244NA/250	Tape and Reel
OPA244PA OPA244UA "	8-Pin DIP SO-8 Surface-Mount "	006 182 "	–40°C to +85°C –40°C to +85°C "	OPA244PA OPA244UA "	OPA244NA/3K OPA244PA OPA244UA OPA244UA/2K5	Tape and Reel Rails Rails Tape and Reel
<b>Dual</b>						
OPA2244EA "	MSOP-8 Surface-Mount "	337 "	–40°C to +85°C "	A44 "	OPA2244EA/250	Tape and Reel
OPA2244PA OPA2244UA "	8-Pin DIP SO-8 Surface-Mount "	006 182 "	–40°C to +85°C –40°C to +85°C "	OPA2244PA OPA2244UA "	OPA2244EA/2K5 OPA2244PA OPA2244UA OPA2244UA/2K5	Tape and Reel Rails Rails Tape and Reel
<b>Quad</b>						
OPA4244EA "	TSSOP-14 Surface-Mount "	357 "	–40°C to +85°C "	OPA4244EA "	OPA4244EA/250 OPA4244EA/2K5	Tape and Reel Tape and Reel

NOTE: (1) Products followed by a slash (/) are only available in Tape and Reel in the quantities indicated (e.g., /250 indicates 250 devices per reel). Ordering 3000 pieces of "OPA244NA/3K" will get a single 3000 piece Tape and Reel.

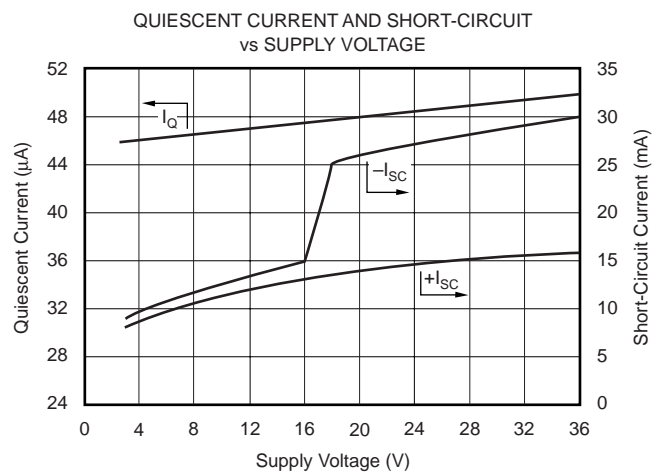
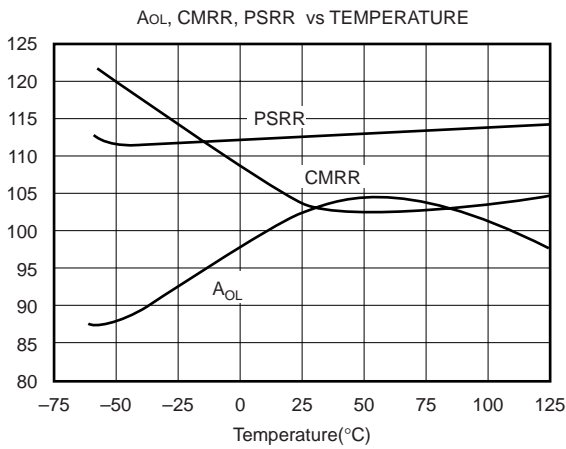
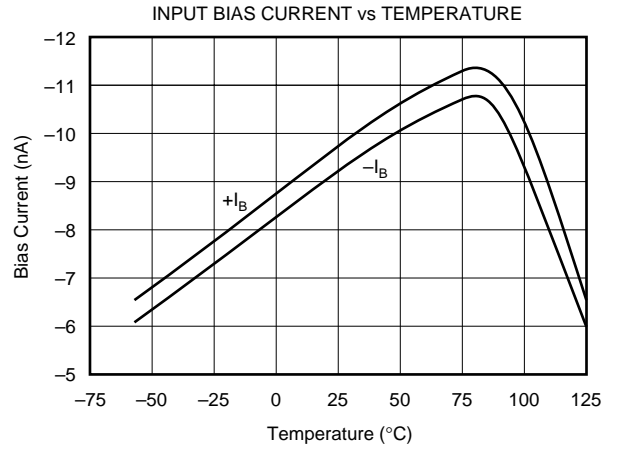
# TYPICAL PERFORMANCE CURVES

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

QUIESCENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



SMALL SIGNAL OVERSHOOT vs LOAD CAPACITANCE





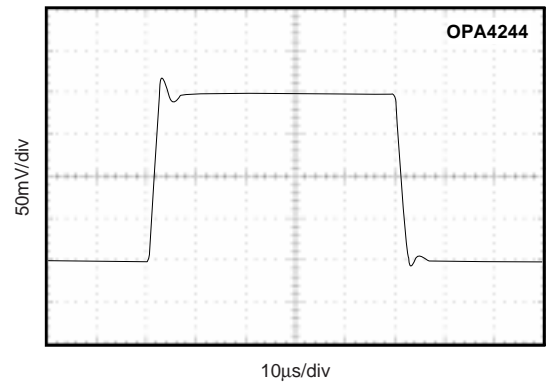
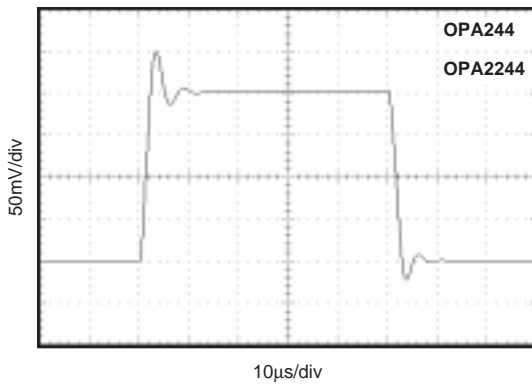
# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

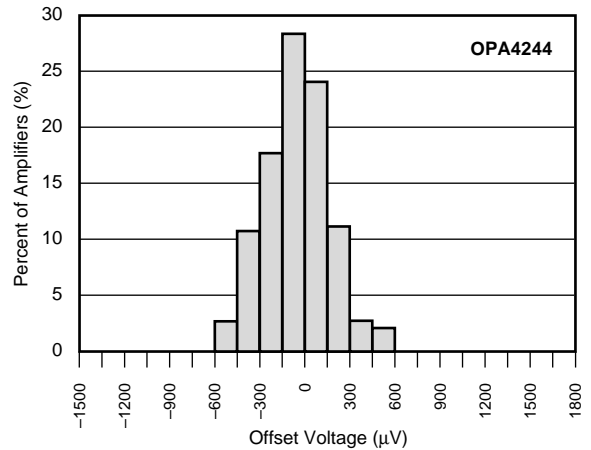
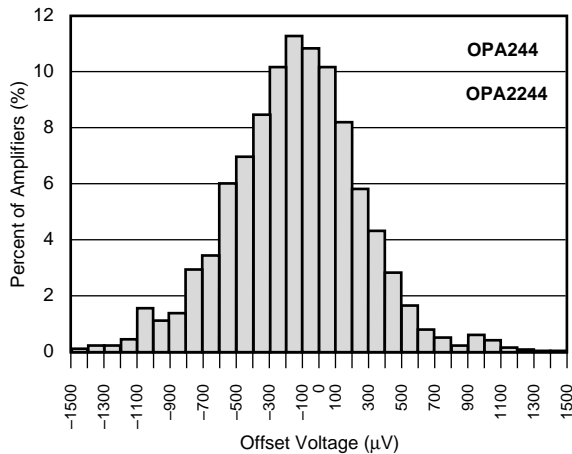
LARGE-SIGNAL STEP RESPONSE,  $G = 1$ ,  $C_L = 100\text{pF}$



SMALL-SIGNAL STEP RESPONSE,  $G = 1$ ,  $C_L = 100\text{pF}$



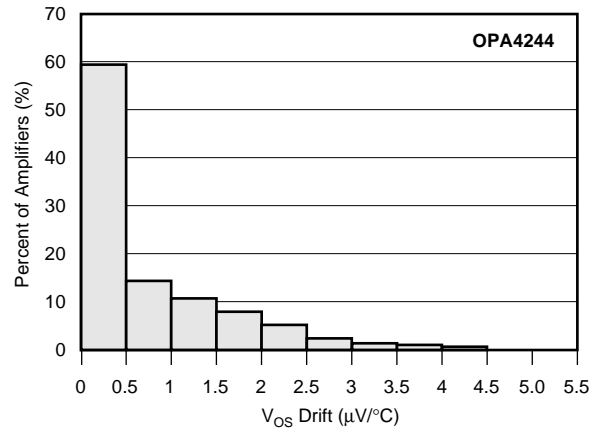
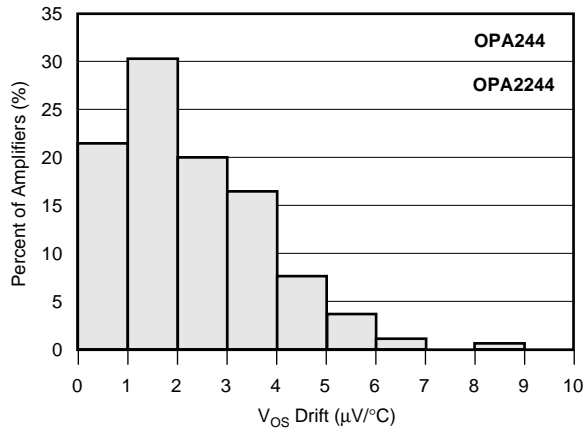
OFFSET VOLTAGE PRODUCTION DISTRIBUTION



# TYPICAL PERFORMANCE CURVES (Cont.)

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +15\text{V}$ , and  $R_L = 20\text{k}\Omega$  connected to Ground, unless otherwise noted.

OFFSET VOLTAGE PRODUCTION DISTRIBUTION



# APPLICATIONS INFORMATION

The OPA244 is unity-gain stable and suitable for a wide range of general purpose applications. Power supply pins should be bypassed with 0.01µF ceramic capacitors.

## OPERATING VOLTAGE

The OPA244 can operate from single supply (+2.2V to +36V) or dual supplies (±1.1 to ±18V) with excellent performance. Unlike most op amps which are specified at only one supply voltage, the OPA244 is specified for real world applications; a single set of specifications applies throughout the +2.6V to +36V (±1.3 to ±18V) supply range.

This allows a designer to have the same assured performance at any supply voltage within this range. In addition, many key parameters are guaranteed over the specified temperature range, -40°C to +85°C. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage or temperature are shown in typical performance curves.

Useful information on solder pad design for printed circuit boards can be found in Burr-Brown's Application Bulletin AB-132B, "Solder Pad Recommendations for Surface-Mount Devices," easily found at Burr-Brown's web site (<http://www.burr-brown.com>).



FIGURE 1. Low and High-Side Battery Current Sensing.

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">OPA2244EA/250</a>	Obsolete	Production	VSSOP (DGK)   8	-	-	Call TI	Call TI	-40 to 85	A44
<a href="#">OPA2244EA/2K5</a>	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	Call TI   Nipdau	Level-2-260C-1 YEAR	-40 to 85	A44
OPA2244EA/2K5.A	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	Call TI	Level-2-260C-1 YEAR	-40 to 85	A44
OPA2244EA/2K5G4	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	-	Call TI	Call TI	-40 to 85	
<a href="#">OPA2244PA</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	OPA2244PA
OPA2244PA.A	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	OPA2244PA
<a href="#">OPA2244UA</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-	OPA 2244UA
<a href="#">OPA2244UA/2K5</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-	OPA 2244UA
OPA2244UA/2K5.A	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 2244UA
<a href="#">OPA244NA/250</a>	Obsolete	Production	SOT-23 (DBV)   5	-	-	Call TI	Call TI	-40 to 85	A44
<a href="#">OPA244NA/3K</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244NA/3K.A	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
<a href="#">OPA244NA/3K1G4</a>	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244NA/3K1G4.A	Active	Production	SOT-23 (DBV)   5	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
<a href="#">OPA244UA</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-40 to 85	OPA 244UA
<a href="#">OPA244UA/2K5</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 244UA
OPA244UA/2K5.A	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 244UA
<a href="#">OPA4244EA/250</a>	Obsolete	Production	TSSOP (PW)   14	-	-	Call TI	Call TI	-40 to 85	OPA 4244EA
<a href="#">OPA4244EA/2K5</a>	Active	Production	TSSOP (PW)   14	2500   LARGE T&R	Yes	Call TI   Nipdau	Level-3-260C-168 HR	-40 to 85	OPA 4244EA
OPA4244EA/2K5.A	Active	Production	TSSOP (PW)   14	2500   LARGE T&R	Yes	Call TI	Level-3-260C-168 HR	-40 to 85	OPA 4244EA
OPA4244EA/2K5.B	Active	Production	TSSOP (PW)   14	2500   LARGE T&R	-	Call TI	Call TI	-40 to 85	

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2244EA/2K5	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA244NA/3K	SOT-23	DBV	5	3000	178.0	8.4	3.3	3.2	1.4	4.0	8.0	Q3
OPA244NA/3K1G4	SOT-23	DBV	5	3000	178.0	8.4	3.3	3.2	1.4	4.0	8.0	Q3
OPA244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA4244EA/2K5	TSSOP	PW	14	2500	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2244EA/2K5	VSSOP	DGK	8	2500	353.0	353.0	32.0
OPA2244UA/2K5	SOIC	D	8	2500	353.0	353.0	32.0
OPA244NA/3K	SOT-23	DBV	5	3000	565.0	140.0	75.0
OPA244NA/3K1G4	SOT-23	DBV	5	3000	565.0	140.0	75.0
OPA244UA/2K5	SOIC	D	8	2500	353.0	353.0	32.0
OPA4244EA/2K5	TSSOP	PW	14	2500	353.0	353.0	32.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
OPA2244PA	P	PDIP	8	50	506	13.97	11230	4.32
OPA2244PA.A	P	PDIP	8	50	506	13.97	11230	4.32





# EXAMPLE BOARD LAYOUT

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

# DGK0008A



# PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4214862/A 04/2023

**NOTES:**

PowerPAD is a trademark of Texas Instruments.

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

# EXAMPLE BOARD LAYOUT

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

# EXAMPLE STENCIL DESIGN

DGK0008A

<sup>TM</sup> VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.



D0008A

# PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

- Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed  $.006$  [0.15] per side.
- This dimension does not include interlead flash.
- Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



PW0014A



**PACKAGE OUTLINE**  
**TSSOP - 1.2 mm max height**

SMALL OUTLINE PACKAGE



4220202/B 12/2023

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

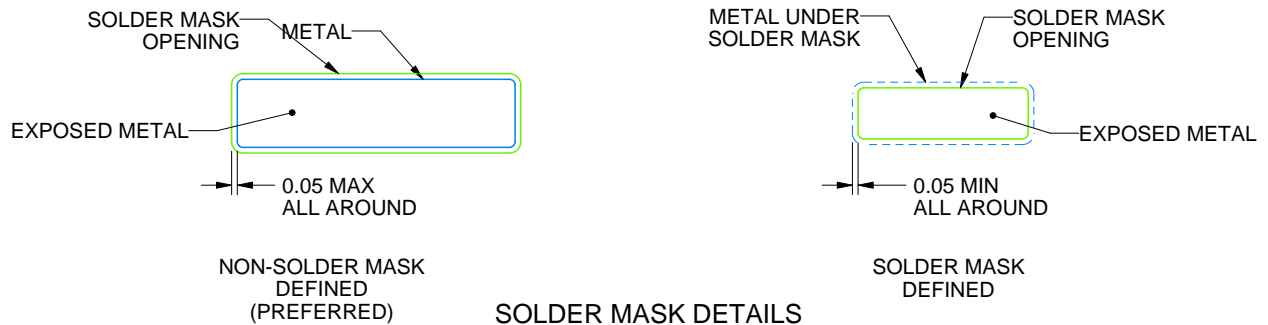
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220202/B 12/2023

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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